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DEMOGRAPHY AND ANTHROPO-GEOGRAPHY

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MANKIND

QUARTERLY

— mala opinio bene parta delectet —

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The Evolution of Man in Relation to that of the Earth Part I*

By WALTER ARNOLD

PREFACE

It is widely recognized that there has always existed a sizeable time-gap between new scientific discoveries and their becoming a part of the knowledge of the people and therefore a general basis upon which judgements and decisions are made. It is not infrequent to find text books failing to mention important discoveries that are five or more years old. Indeed, some of the most important industrial reactions in the world, such as the formation of alkyd resins and many important polymerization reactions, are often neglected or entirely omitted. This may be a result of the lack of interest and knowledge of the accomplishments of the industrial world on the part of the academic and government scientists. Some knowledge time-gap is certain to be ever present, but in this fast moving era of scientific exploitation it is more important than ever before to keep our thinking and actions as closely in tune with current discoveries as possible. Only in this way will the actions of man, his accomplishments and more important his goals best be evaluated and defined.

In this post-Christian era of Western culture resulting more from the suicide of the Christian church than from the "death of God," Western man's future course depends largely upon what recent scientific knowledge reveals regarding the nature of man and his environs. He no longer can depend upon the Christian ethic to guide him. Indeed, even if Western culture still possessed faith in the doctrine and teachings of the Christian church and its leaders, it would be necessary to rationalize these teachings with the revelations of science. Especially is this true with respect to the religious views on creation, of which man is a part. The failure of the Christian church to accomplish this is perhaps more owed to the deficiencies and ignorance of the church hierarchy and leaders than to the inadequacy of the faith itself. Genesis according to science then becomes the foundation of man's rationality and provides the guide lines of his future and conduct.

The failure of Christianity, the failure of "democracy," the failure of the socialistic state, all serve to present reasons why it is so

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important to examine man and his environs from a strictly objective and scientific point of view. Only such a "size-up" can lead to an understanding of man and his behavioral patterns. Until this understanding is obtained, man's improvement cannot be precisely nor properly prescribed.

Expediency and subjectivity are too often responsible for obscuring the true knowledge leading to an honest understanding of man or even obscuring studies leading to an understanding. Many psychologists and "social anthropologists" in the United States, for example, impose upon the country the unsubstantiated doctrine that all babies, regardless of heritage or cultural background, have the same learning potential at birth. As a result of their dogmatic views, they obstruct all studies that might verify or deny their contentions. Their attitude can be explained only by assuming that they dare not allow honest studies for fear of their views being proved wrong. This places them in a position to be under suspicion of basing their views subjectively to serve the purpose of promoting certain philosophies that are favorable toward the perpetuation of political power. The moneys for studies, whether from government or from large foundation sources, are too often channelled to support the subjective aims of such power-hungry groups rather than unbiasly distributed on a just basis from an objective and scientific point of view.

In the meantime there is building up in the world of science a truly vast warehouse of potential power and means of dominance. Various forms include euphenics, that is the construction of artificial organs used to replace natural ones and the transplantation of natural organs; and, euthenics wherein infectious diseases are eliminated or controlled by creating through social or behavioral reforms environments unharmonious to the disease. Other power feats that are foreseeable or already within grasp include the alteration of genes to bring about on order and, in accordance with specifications, either "good" or "bad" changes in successive generations. Not only is it possible in this way to bring about changes in the physical characteristics of the organism but it is also possible to alter the psychic capacity both qualitatively and quantitatively. The intellectual characteristics of future man is thus within the scope of man's own ability to prescribe. While that aspect of man's psychic composition that is innate can be altered by man himself, he also finds himself gaining more and more means by which he can control the learned aspect of man's psyche. For example, the power of mass hypnosis in various forms, such as post-hypnotic suggestion, is within the power of those who might control television. The mass "brain-washing" of whole peoples to a particular point of view is demonstrated often by those who are able to use all the various forms of news media to serve such ends. The advances in chemical warfare, such as the capability of poisoning vast populations or the rendering of them docile or inactive, make these and other power acts possible.

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This era marking the closing of the twentieth century therefore represents a period in which many new advances in sciences become incredibly great power implements over man. Their potential effects on man are so overwhelming that they make nuclear bombs and the conquering of space look in comparison not so awful. Is it any wonder that politicians grasp every opportunity to devise means to take control of organ transplantations and other scientific developments? Are we to believe that politicians and the civil servants they create are the only ones upon whom we can rely to trust in such matters? Who is to possess all this vast power? A handful of politicians? If so, what standards are to be used in forming judgements and making decisions? It is possible and likely for the vast power of these new scientific advances to become vested in but a handful of people. Will the intellectual, cultural and psychological characteristics of mankind of the future be determined by these few?

Before man's course for the future can be plotted, goals must be established that are conducive to the perpetuation of man. Unless goals are chosen that satisfy his nature and take into consideration his capabilities and his limitations, man may well perish. In other words, it becomes of first importance to learn everything possible regarding man, his composition, his origin, his physical and psychic characteristics, how he became what he is and why his behavior is what it is. He is a result of evolution through natural selection and his physical characteristics have reached a high stage of development. From this point forward his greatest evolutionary development will center on his psyche and he, himself, must chart the course. The degree of excellence with which he accomplishes the plotting of this course of the future will be in direct proportion to the extent to which he develops a knowledge of himself, particularly an understanding of his behavioral characteristics and his nature.

This dissertation therefore is an effort to set out concisely the nature of creation as we know it in the last part of the twentieth century from that scientific knowledge that accumulates faster than it can be popularly comprehended. The information set out represents accepted and generally dispensed facts, theories and propositions. These are presented in a manner that is intended to emphasize the nature and characteristics of man and his environs as revealed by these current scientific discoveries and observations. From such an analysis, the evolution of the psyche emerges as the least understood, the least considered, and indeed the most important single factor of rational man. The nature of man, with all his possible traits and instincts, is examined in the light of his behavior and the observed behavior of other animals. From this examination, the current struggles in the world are evaluated.

It is hoped that this presentation will serve to stimulate recognition of and interest in the factors that account for the behavioral patterns of man. It is also intended to be directed to those o

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thoughtful minds who are interested in the nature of man and how they could view mankind objectively and thus be able to design more rationally remedial measures for today's crises and better to project man into the future.

INTRODUCTION

The twentieth century finds man beset with frustrations resulting primarily from not being conscious and aware of what part of his knowledge constitutes truth and what part constitutes fallacy. Consequently, there are unrecognized contradictions that have prevailed in his life which are still influencing the course he travels into the unknown future. If man is to continue his advance forward along the path of human enlightenment, it is essential that he take stock of the knowledge he has acquired and thereby judge what are and have been the accepted truths and certain untruths which have guided his course to this point in his development. Only by recognizing the truths and only by acknowledging and rejecting the untruths will he be able to chart his course of the future in a manner that will lead to his salvation rather than to his premature destruction. In this way not only will it be possible to know for what it is best for man to strive—what his objectives should be—but it also becomes possible to choose the best route to follow in reaching these objectives.

In order to provide a wide and deep backdrop of information from which to make judgements and acquire better understanding, it serves a real purpose to recount briefly the general nature of the physical existence in which man finds himself. Since man is an integral part of the existence he finds around him, he certainly cannot place himself in proper perspective without being ever conscious of his environs. Thus man also becomes reminded of the enormous period of time involved in his appearance as man and how very short indeed is the period of time of his individual life and hence of his individual enlightenment. Only through humility gained by such realizations will he be able to question all aspects of the culture in which he finds himself and avoid the pitfalls resulting from the false guidance of untruths so often imposed for the benefit of subjective purposes and ambitions.

A short review of present knowledge as well as an honest speculation of the nature of physical existence is undertaken. No attempt is made to give minute details of the nature of discoveries or the detailed arguments of speculations. Instead, the fundamental concepts and theories only are described in hopefully simple and direct language.

Now, as never before, man can become mentally engrossed in the magnitude of his surroundings by projection into the infinitely large as well as into the infinitely small. When projecting into the infinitely large, Galileo found an indisputable truth that the earth revolved

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about the sun and was not a center point around which the sun revolved. Many civilizations before had observed this truth. However, it is perhaps unique to Western culture that the revelation of this truth was treated as a heresy by the church which had proclaimed that the sun revolved about the earth. Severe punishment was inflicted upon those who challenged this false declaration of the Western religious leaders who had unnecessarily and unwisely committed themselves to an untruth. Rather than objectively recognizing the truth, they chose the course of subjectively denying a truth in order to save face or to avoid the act of admitting the human error of false conclusion. Thus there resulted a self-imposed and enforced restriction to further growth of enlightenment. Man can and will no longer afford such subjectively imposed throttles to his enlightenment.

The fact that life on earth had a beginning (alpha) and is destined to have an end (omega) places emphasis on the importance of realizing that rational man is derived from a naturally occurring series of events, the knowledge and understanding of which actually serve to help define man. Equally important is an exploration into the realm of the infinitely small. In this manner, an understanding of the chemical and energy entities that are common to both man and his surroundings becomes conceivable. Consequently, to understand the composition and the nature of the whole universe helps one to accept man's position in it. The fact that the whole of creation is a dynamic system undergoing a never-ending cycle of changes makes the short life span of an individual man rationally comprehensible. The continuous changing of a living organism from birth to death is indeed conforming with the universal pattern followed by the whole universe itself. This, then, is the nature of existence of which man cannot ever be the author. Indeed, he must accept the nature of existence as he finds it. To understand this truth enables man to accept those conditions in which he is ordained to exist and from which he has no escape.

In order for man to possess dignity, he must first know his nature and whence he came. A knowledge, therefore, of the changing conditions leading up to the initiating of life on earth and the final emergence of man becomes basic and is the cornerstone of his dignity.

A consideration of the conditions that had to exist in order for man to appear as an evolved being of rationality is fundamental to being able to understand how man became master of the physical environment about him. Therefore, knowledge of the transition wherein man no longer depended upon natural selection to adjust him to changing environments but instead wherein he gained control of his environment, indeed leads us to the answer as to how man became master of all forms of life over all the earth. Considerations of how this transition occurred allows one better to comprehend the

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present day ability of man to utilize nature. For example, by constructing dams, he harnesses nature to generate electric power and to provide irrigation.

To reach this stage of mental or psychic development, the process of evolution through natural selection had to shift its emphasis from the evolution of the physique to that of the psyche (mind). Since the evolution of the psyche becomes in the future the main factor measuring man's advance, a recognition and a study of this process becomes rudimentary to his further progress. Without such considerations in his thinking, instead of advancing forward, he becomes trapped by his progress.

Man emerged, he developed and, by inventions that control events or occurrences, he became master. The evolution of his psyche eliminated to a large degree the play of chance. Instead, he used his newly acquired ability to make-to-order certain future events.

If there is to be an understanding of the difference in the characteristics, mannerisms and behavior between various segments of mankind, consideration must be given to the instincts inherited by man and which are the hallmarks of the evolutionary development through natural selection of the human psyche.

Accounting for the very vast differences between the races of man requires recognition of differences in the psychic level between races. It is this hypothesis that also allows one to understand the driving forces in mankind that chart the course man follows in his continued journey up the path of higher psychic development.

THE INFINITELY LARGE

In order to describe and comprehend the factor of the infinitely large, it is useful, if not necessary, to consider the character and dimensions of the universe of our existence.

SOLAR SYSTEM

About the sun in a disc-shaped plane are to be found the planets as they circumnavigate the sun in defined orbits. About the planets orbit planitary moons or satellites. Thus is our solar system constituted. The size of the solar system is found to be about seven billion miles in diameter which is indeed small when compared to other dimensions of the universe. The age of our sun is now estimated to be five billion years and that of the earth four and one half billion years.[1] The sun is regarded as having a life period of

[1] Relative decay rates of radio active elements are employed to measure the age of planets. The unit of measure is a current earth year or the time lapse of a current orbit about the sun. The use of the time unit, the earth year, affords comprehensibility and provides a means of expressing accurately relative time periods.

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about ten billion years. It is observed that, as stars such as our sun grow old, they suddenly expand or explode causing the orbiting planets to vaporize. Thus the identity of all planetary systems, including such planets as the earth, is sure to end. Consequently, life on earth is finite.

GALAXIES

The solar system, in turn, is only a speck within a larger system, the Milky Way galaxy. The Milky Way galaxy is a pancake-shaped disc extending some ninety thousand light years across.[2] This formation is composed of perhaps one hundred billion stars such as our sun, many, if not all, with planetary systems. Our Milky Way galaxy is, in turn, only one of perhaps one hundred billion galaxies that compose the universe (or creation). The age of the universe in which we exist is regarded to be about twelve billion years. It is thought that the universe probably started as a result of a cataclysmic explosion from a point from which the formation of the universe has continued to spread or expand. It is thought that this expansion process is to continue for a period of forty-one billion years, twelve billion having already elapsed. Since it appears that the universe is finite in nature or is a system with limits, a closed system, the expansion will bend or fold back. Thus the process of expansion reverses itself, or a process of shrinking or condensation finally occurs. This contraction process continues for a time, perhaps equal to the period of expansion—forty-one billion years. Thus the cycle of expansion and coalescence consumes a total time element of approximately eighty-two billion years. This pulsation starts afresh with another cataclysmic explosion when a certain critical density resulting from the coalescence has been reached. Cyclic pulsations without end or beginning are thought to occur.

Galaxies are observed that appear to be in the process of being born. The most distant quasar (galaxy birth) so far observed, called 3C-9, is perhaps 8·7 billion light years away. What is seen today as 3C-9 therefore is the quasar as it appeared perhaps eight billion years ago when the universe was only four billion years old. It is possible that this then represents a picture of the state of our galaxy when only one third its present age. The quasars are one hundred times the brilliance of ordinary galaxies.

In addition to newly-born galaxies there are blue galaxies that are found to be five hundred times more numerous within our scope of identification than the quasars. Blue galaxies are very brilliant, as are quasars, but are not as high a source of strong radio emission as are quasars. Within the capabilities of identity by man there are one hundred thousand ordinary galaxies for every one blue galaxy.

[2] A light year is the distance light travels in one earth year, the rate being 186,000 miles each second.

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Recent scientific evidence indicates that the void between galaxies might not be an empty vacuum but instead could be a form of hot, very thinly dispersed hydrogen gas, there being one atom of hydrogen in perhaps a space of one cubic meter. Though this may seem slight indeed, the space between galaxies is so great that the collective mass represented by this low density hydrogen is far greater than the mass of all the galaxies of the universe combined.

EXTARS

Just as there are galaxies in various stages of development as the universe continues its process of expansion, there are also stars within galaxies that are in the process of being formed. Such astronomical bodies indicating stellar births are called extars (derived from X-ray). It is thought that these bodies result from a high concentration of gas and cosmic dust that coalesces in a continuous process forming a gravitational center. The exact composition and nature of interstellar dust has been guessed to be ice and graphite. The presence of chlorophyll compounds in significant quantities has been claimed to be identified. If true, such compounds could continue to fall on newly formed and cooled-off planets, thus providing on such planets growth resulting from photo-synthesis, that is, the reaction wherein carbon dioxide and water together with light energy forms sugar, energy and the life process itself.

During the early stages extars are quite transparent. The density of the center of this nebula increases as does also the rotational rate. The mass of the total original cloud (nebula) consequently shrinks. Eventually the density of the center builds up enough heat to cause the initiation of thermonuclear reactions. Thus a sun is created while still capsulated by the cloud of the original nebula. The particles in the cloud continue to be pulled to the gravitational center of the new sun. In the process of movement toward the center, some of the cloud particles collect into orbiting higher density masses that create relatively smaller gravitational fields of their own. Thus there occurs at periodic intervals about the new sun high density masses that attract to themselves more matter from the nebula as this matter is attracted toward the new sun. Eventually there develops a planetary system about the new-born-center or sun. It becomes now possible to speculate that satellites of planets such as the earth's moon could be formed and take their positions in orbits about a planet in much the same manner that the planets formed and positioned themselves in orbits about the sun. Therefore, the earth and the moon were both probably formed from the same preplanetary dust cloud. Hence the basic composition of the moon is likely to be similar to that of the earth.

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The formation of planetary systems within a galaxy is therefore regarded as a natural phenomenon, at least during the expansion portion of the pulsating life-cycle of galaxies and, indeed, of the universe.

There are perhaps over one hundred billion stars in the Milky Way galaxy alone, and there are likely also one hundred billion galaxies in the universe. Of the ten trillion or more stars in the universe it is more than probable that there exist countless billions of planets in solar systems similar to ours. Among such a vast incomprehensible number, there is certain to be found many planets that have environmental conditions conducive to the existence of life as we know it. Indeed, with such limitless probability, it can be reasoned that there also exists other intelligent life in some form and in many instances throughout the vastness of the universe. In fact the probability of the existence of life in many instances throughout the Milky Way galaxy is further increased because new planetary systems continue to be formed as the galaxy continues to transform itself from gaseous systems into solid ones, since the galaxy is still in the expansion period of the pulsating cycle.

EXTRA-EARTH LIFE

Methane is known to be an important component of comets and the planets Jupiter, Saturn, Uranus and Neptune. Although these planets are themselves cold, their outer extremities no doubt absorb much solar radiation and heat. It is now known that at temperatures of 1800°F. methane becomes converted to aromatic hydrocarbons such as benzene and naphthalene. The formation of these compounds, although they can be made synthetically, are usually said to be associated with the remains of once living creatures. It becomes reasonable to assume that conditions could occur on some planets whereon there is produced directly and synthetically petroleum products that were previously assumed to have had their exclusive origin from some form of life.

The behavior of matter at ordinary temperatures, pressures and densities is well known, but the behavior of matter at temperatures of 1800-2500°F. is only now being observed and studied. As such knowledge is accumulated, much should be learned regarding the formation of planets. Owing to the severe density imposed upon the swirling particles that coalesce by chance to form a planet rather than to be drawn directly into the center of the star, there exist in the center of a planet very high temperatures. For example, the estimated pressure at the earth's inner core is three million atmospheres. The core is largely iron and its density in the core under three million atmospheres pressure is about twice that at sea level pressure (one atmosphere). On this basis it is calculated that the earth's iron core

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rests at a temperature of about 6700°F., which is only about half that once estimated. This information, when applied to planets and their satellites, should serve to explain much regarding the conditions—size, location with respect to the sun, and so on—that a planet must possess in order to provide conditions conducive for supporting life.

INEVITABILITY OF EARTH'S CREATION

It is necessary to grasp the magnitude of creation about us if we are to realize that the creation of the earth as we know it could not have been avoided. The enormity of creation and the endless time element involved means that, so long as the occurrence of the earth falls within the borders of possibility, it definitely must appear. Given sufficient time, regardless how poor the odds, the happening will occur. This same reasoning becomes the basis for an understanding of the emergence of man on the earth.

In order to understand the occurrence and the complexity of the life process, it is necessary to focus one's attention on the enormity of existence and endless time factors present. The enormity and the endless time factor themselves can, in large part, account for the probability for the occurrence and development of life processes.

TIME RELATIONSHIPS

	Billions of years
Age of sun	5·0
Age of earth	4·5
Sun's life-period expectancy	10·0
Age of universe	12·0
Expansion period of universe	41.0
Unexpired portion of expansion period	29.0
Contraction period of universe	41·0
Expansion-contraction cycle of universe	82·0

NUMERICAL RELATIONSHIPS

Milky Way galaxy	100 billion sun-stars
Universe	100 billion galaxies or 10,000 billion stars or 10 trillion stars
Number of planets in universe	countless billions

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THE INFINITELY SMALL

Just as a concept of the infinitely large is necessary to relate the existence of man to his environment, so is it also necessary to consider the infinitely small. An understanding of the nature of man begins with a knowledge of the smallest entities that constitute his composition.

ATOMS

The lightest of all elements is hydrogen. The nucleus of an atom of hydrogen is composed of one proton. The nucleus of the next heavier atom, helium, is composed of two protons and two neutrons. The nucleus of the next heavier atom, lithium, consists of three protons and three neutrons, and so on throughout the periodic table that expresses the periodic law of the elements and their isotopes.

The neutron component of atomic nuclei is a body possessing no electrical charge. It is thus electrically neutral with respect to the positively charged proton as well as to the negatively charged electron. Each proton component exhibits a unit positive charge of electricity and about each proton orbits an electron which is negatively charged, the electrical opposite of a proton. Its mass, however, is only 1/1845 that of a proton. Electrons are entirely electromagnetic, consisting of cathode and beta rays. They are emitted by hot bodies.

HYDROGEN ISOTOPES

One of the three isotopes of hydrogen is called deuterium or heavy hydrogen. The nucleus of an atom of deuterium consists of one proton plus one neutron. (Nuclear force holds together protons and neutrons forming the nuclei of atoms). An atom of deuterium is heavier than an atom of hydrogen by the weight of the single additional neutron in its nucleus. It is found that deuterium exists in nature—one atom of deuterium to about 6-10,000 atoms of hydrogen —wherever hydrogen-bearing compounds such as water (H_2O) exist. The earth's oceans are so vast that even this low ratio of deuterium to hydrogen means that there are stored therein vast quantities of deuterium which represents an equally vast warehouse of energy.

When deuterium atoms are bombarded by high energy deuterons, deuterium nuclei, tritium is formed, along with a third isotope of hydrogen called protium—$D^2+D^2=H^1+T^3$. Tritium is present in natural water and could occur as a result of cosmic rays reacting with nitrogen in the high atmosphere—$N^{14}+n^1=C^{12}+T^3$. Tritium is produced by the nuclear reaction between lithium 6 and neutrons from nuclear fission reactors—$Li^6+n^1=He^4+T^3$. In natural water, one atom of tritium exists for 10^{18} atoms of natural hydrogen. Tritium is radio active, having a half-life period of $12\frac{1}{2}$ years—that is,

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a given mass of tritium will have half decomposed through radio activity in 12½ years. Whereas the nucleus of an atom of deuterium consists of one proton and one neutron, the nucleus of an atom of tritium consists of two protons and one neutron. The nucleus of an atom of helium contains two protons and two neutrons.

NUCLEAR FUSION—H-BOMB

Nuclear fusion is the process resulting when a nucleus such as that of deuterium collides with sufficient force with one of tritium forming a nucleus of helium by releasing one neutron and vast energy. This process of nuclear fusion is what occurs under the surface of the sun and is responsible for the vast energy that finds its way to earth in the form of heat and light. In the hydrogen bomb this welding or fusing of heavy hydrogen atoms is an instantaneous reaction. Once this reaction can be controlled, the source of usable energy in the world will be practically inexhaustible and applicable in any location. The solution to this problem is the object of considerable research in the world. A group of German scientists working under the auspices of the Max Planck Institute believe the control of this reaction is within grasp in the twentieth century.

The fusion of two nuclei of deuterium is brought about by the introduction of enormously high temperatures, perhaps as high as 100,000,000°C. To accomplish this, a small atom bomb (nuclear fission) is discharged. This provides the high temperature that triggers the instantaneous fusion reaction. The high temperature creates ionized hydrogen gas called plasma which gives way to the instantaneous fusion reaction releasing such vast energy as manifested in the discharge of the hydrogen bomb. There are, therefore, two factors or conditions to be met in order to control a nuclear fusion reaction and make it a more useful form of energy: the achievement of an optimum high temperature and the means to hold quiet in a state of rest the resulting highly ionized hydrogen gas or plasma.

The German scientists Dr Gerhart von Gierke and Dr Günther Grieger of the German Max Planck Institute reported in August of 1968 at an international meeting in Newosibrisk, Russia that they had developed a specific procedure wherein highly-heated ionized gas or plasma can be enclosed or confined in a state of complete rest within circular magnetic fields. Thus the way is made open for mankind to be provided with virtually unlimited and inexhaustible energy.

The fusion process using deuterium can produce vast quantities of energy. For example, the deuterium in one pound of heavy water will liberate power equivalent to that obtained when one million pounds of coal are burned. There is enough deuterium in the oceans to provide the world for a billion years with many times the energy it now consumes.

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Nuclear fission, another process that releases the energy of the atom, is the process of splitting a nucleus such as a uranium 235 nucleus which releases or sets free neutrons along with (enormous) quantities of energy. A nucleus is split by "firing" a neutron at the nucleus.

An atom of uranium (U-238) contains a nucleus of 92 protons and 146 neutrons with an outer shell containing 92 electrons. Early in 1939 two German scientists reported the discovery that by bombarding an atom of uranium with a stream of neutrons the uranium atom could be split. With such a split or fission, there was released some of the atom's nuclear energy. Such a splitting of the atom could be done under conditions that would result in a chain reaction that would or could result in an atomic explosion. The entire world of physicists was soon to verify the findings of the German scientists and it was only a matter of a few months (on 2nd August 1939) that Albert Einstein wrote President Franklin D. Roosevelt the news. Einstein was for some reason the spokesman for the physicists, but only their spokesman. Actually his knowledge on this subject was certainly no broader than other physicists and he was not so well informed as many German and other scientists of the time.

The discovery that the atom, uranium, could be split into less heavy elements was made in December of 1938 by Professor Otto Hahn and his colleague, Fritz Strassmann. Their work in Berlin demonstrated that bombardment of uranium by neutrons resulted in the splitting of the uranium atom and that more neutrons were freed in the process than were used. This, of course, resulted in a chain reaction from which enormous energy was released. There can hardly be any doubt who actually was the "father" of the atom bomb, notwithstanding the multitude of A-bomb father-claimers of the United States of America. Since Professor Hahn's work was in no way motivated by the quest of the A-bomb, he was never one to claim that he sired it. Instead, his interest, as well demonstrated by subsequent work, centered on the benefits of his discovery to mankind rather than on mankind's destruction. Among his contributions were several radio-active compounds of great use in medicine.

For every 139 atoms of uranium found in nature there occurs one atom of an isotope of uranium called U-235 which can be separated from uranium by a process depending upon the difference in the physical weight between U-238 and U-235. This process is called the "gaseous diffusion method." When the atoms of U-235 (an isotope of uranium, or also plutonium) are struck by stray but high speed neutrons, the U-235 (or plutonium) atoms are split. During this splitting process a minute quantity of the original mass of the atom is converted into an enormous burst of energy. During this fission, there is also released from the splitting atom two or three neutrons which proceed to collide with and split other U-235 atoms.

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When a neutron from a splitting U-235 atom collides with an atom of U-238, the neutron is absorbed by the U-238 and thus an atom of plutonium is produced. Plutonium practically does not exist naturally. Plutonium, like U-235, is a fissionable element which can be split by a colliding neutron. The splitting of plutonium releases more neutrons to initiate and to propagate a chain reaction.

In order for an atomic explosion to occur, a certain critical mass of fissionable material must be present. This is said to be about thirty pounds. Therefore an A-bomb can be designed by keeping separated two quantities of fissionable material (U-235 or plutonium), and then by causing these two quantities to be suddenly united. An instantaneous explosion will occur if the two parts exceed the critical mass. A saw-tooth design on the two parts would provide a very effective union.

Plutonium is produced by using an atomic pile which consists of a large mass of graphite through which pass aluminum tubes. Rods of natural uranium (99 per cent U-238, 1 per cent U-235) are inserted in the tubes. Spontaneously fission occurs in some U-235 atoms and two or three high speed neutrons per each U-235 fissioned atom are released. Some of these neutrons are absorbed by U-238 forming plutonium but other neutrons are dissipated into the air. Without a pile, so many neutrons are lost that the reaction stops. With a pile, however, the neutrons are slowed down as they pass through the graphite. They are slowed so much that only part of them are taken out of circulation by becoming imbedded in U-238 atoms forming U-235. The even slower neutrons do not become imbedded in U-238 but continue on until they strike a relatively rare U-235 atom causing another atom split. Thus plutonium is continuously formed and further fission of U-235 provides more neutrons to perpetuate the process. To avoid this reaction from over-heating and melting the pile, rods of cadmium are lowered into the pile where they soak up some of the neutrons making U-238 into plutonium and some of the others that cause fission of U-235 to keep the reaction going. The reaction can therefore be controlled by raising and lowering the cadmium rods in and out of the pile. After most of the U-235 atoms have been used up, the rods of uranium are very radio active with plutonium. The plutonium is then chemically separated from the uranium using acid and then it is used as material for atomic explosives.

NUCLEAR POWER

Noteworthy and far-reaching refinements of the use of the fission process as a source for atomic power have been accomplished by scientists of the Federal Republic of Germany. These refinements include methods resulting in greater efficiency of the use of uranium and methods whereby the fission process can be confined to a device

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occupying but little space and weighing only about 1000 kilograms. By using rapid "breeder reactors," for example, more nuclear fuel is produced than they themselves consume. This means that, by employing rapid "breeder reactors" to generate electricity, for example, less uranium is consumed and less maintenance is required; the cost of electricity becomes decidedly cheaper. A small nuclear fission reactor, called ITR (Incore Thermoionic Reactor), is no larger than a bread tin and weighs about a ton. It consists of "fuel sticks" of highly enriched uranium (U-235) and is cooled by liquid sodium and converts the heat produced from the nuclear fission directly into electrical energy, thus avoiding the energy loss of generating steam or other propellant. Such a source of energy can easily be the deciding factor in man's success in conquering space. The decision of the Government of the United States of America to abandon work on such an energy source for conquering space might well be viewed in the future as a milestone in the loss of leadership of Western culture by the United States.

The use of nuclear power as a source of useful energy to replace such other energy sources as coal, oil and gas is sure to be developed more and more. The use of the controlled fission process described above depends upon a supply of uranium which is limited. Also, the disposal of the poisonous radio active residues from fission is a serious problem. It is for these and other reasons that it becomes very desirable and indeed necessary to learn to control thermonuclear fusion so that it can be used as a useful source of energy. Because of the relatively large quantity of deuterium in sea water, controlled nuclear fusion would represent an inexpensive and almost limitless source of power.

A consideration of the atom from the stand-point of its physical components as well as its energy content serves to provide a comprehension of the stuff with which man and all other existing matter is composed. Furthermore, a contemplation of the feat of the discovery of atomic energy serves very well to illustrate that the evolutionary forces now at work on the species, man, are concentrated primarily upon the progressive development and improvement of his capacity for intelligence. With respect to man, ever since he crossed that threshold that elevated him intellectually above the other members of the animal kingdom, the evolutionary process has emphasized the intelligence factor more than the factors directly affecting man's physical body.

BASIC UNIT OF CREATION

The ancient Greeks defined the atom as the basic particle of the universe—that mass of an element that was incapable of further subdivision. Not only has the nucleus of an atom been discovered as a more basic stuff of the universe, the nucleus itself is composed of

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still more basic stuff such as neutrons. In addition it is known that there are at least thirty different particles of energy scattered by a splitting atom when neutrons are released. There is evidence proving the existence in the nucleus of the neutrino. This could be the basic unit of the universe. A neutrino has no electric charge or mass of its own. It travels at the speed of light and can penetrate matter equivalent to 100 million miles of lead without being stopped. Neutrinos are found in man-made nuclear débris. Though not easy to identify, it is thought now that natural neutrinos have been found. It is wholly possible that these entities are the basic component from which all matter is created.

Man's knowledge of the universe leads to an almost incomprehensible enormity—the infinitely large. No less incomprehensible is man's knowledge of the components of matter which leads to an almost incomprehensible minuteness—the infinitely small. Only by focusing one's thoughts on the infinitely small can one come to realize the almost incomprehensibility of the elemental basic components of which he and his environment are composed. The vast magnitude of the number of such elemental basic components coupled with the fact that all of creation is in a continuous state of dynamic motion forms a further understanding of the inevitability of the life process occurring. When one then superimposes upon these realities the presence of an unlimited time factor, it becomes possible to realize that a probability, regardless of how remote, does exist for the life process to occur. Given a dynamic system of infinite magnitude, infinite minuteness and an unlimited time factor, the life process had to occur. Avoidance of the life process under these conditions becomes impossible.

THE INITIATING (ALPHA) OF LIFE

The age of our sun is estimated to be five billion years and that of earth four and a half billion years. The sun is regarded as having a life period or an existence period of about ten billion years. When stars similar to our sun approach the end of their existence period, they explode causing, through vaporization, the disappearance of their planets as well as themselves. The life of our solar system, accordingly, is approximately half spent. Any and all life in our solar system including life on earth is therefore certain to end. There remains four to five billion years before the absolute cessation of life, the omega of life, resulting from the explosion of the sun. Some scientists postulate that the planet Mars, which is believed to support now some fragments of life, once supported an environment one and one half million years ago that allowed life to flourish much as it does today on earth. If this is true, and if in the future the environment

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for life on earth follows the same course as it did on Mars, life on earth may have an expectancy period of only a few million years. It is thus easier to predict the end of earth's life and to explain the causes of the cessation of life, the omega of life, than to explain the creation or initiation of life, the alpha of life.

At some time over the past four and a half billion years that the earth has existed, the life process began. Rocks 2·7 billion years old, as determined by radio-active dating, are found which show the existence of micro-organisms and these micro-organisms did not much resemble the ones of today. How much previous to 2·7 billion years life existed is difficult to ascertain because the rocks containing evidence of organisms of those times have been subjected to such extreme pressures, temperatures, and so on, that they have lost much of their original character, such as the residues of living organisms. The Komati River Valley in the eastern Transvaal is thought to contain the oldest and least distorted igneous and sedimentary rocks on the earth's face. These rocks are estimated to be 3·2 to 3·5 billion years old and they are reported to contain evidence of one-celled fossils resembling algae and bacteria. If these observations are valid, the life reaction on earth could have been under way 3·5 billion years ago.

THE PREBIOTIC PERIOD

The very beginning of the earth was marked by an accumulation of gas and cosmic dust as they were drawn toward the center of our sun. The concentration of gas and interstellar dust results in a higher density which at the start possesses a small gravitational field of its own. The setting up of such gravitational fields about the sun provides the basis for a periodically spaced group of high density masses that attract to themselves more particles from space. Thus are the planets initially formed. Between the time of the formation of such a high density mass and 2·7 billion years later, life appeared on earth. At just what instant during this time period the alpha of life occurred is not known. It is assumed however that life was not able to occur in a too thin mass and that it took perhaps a billion years for a density to form sufficient to support the very beginning of life. If this assumption is true, the very first occurrence of the life process on earth occurred sometime after the first billion years but previous to 2·7 billion years. The period of time before the occurrence of the life process is referred to as the Prebiotic Age. The Prebiotic Age therefore is the time which was required for the proper conditions for the support of the life process to become established. Assuming that there were present methane, ammonia and nitrogen gases together with oxygen-bearing compounds, a reaction of some sort occurred giving rise to proteins and nucleic acids, the building blocks of the life process. The physical conditions necessary for the

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formation of proteins and nucleic acids could possibly have included very low temperatures where the atoms of hydrogen, nitrogen, carbon and oxygen were forced together in a fashion to create the molecules of proteins and nucleic acids. The physical conditions necessary for the formation of proteins and nucleic acids could also have included very high temperatures resulting from lightning discharges.

The Prebiotic Age finally found the earth surrounded by an atmosphere. The density of this atmosphere in which the building stones (proteins and nucleic acids) of life were created might well have been high (thick). If such an atmosphere contained methane, ammonia and oxygen compounds, the high density is assumed to assist in the reactions leading to protein and nucleic acid molecules that were perhaps catalysed by various forms of radiation. It is also speculated that the environment in which proteins and nucleic acids were formed might have been a thin mixture of carbon monoxide, nitrogen and hydrogen.

THE ALPHA OF LIFE

Whether the temperature was very high or very low, whether the medium was dense or rare, the fact remains that the elements nitrogen, carbon, oxygen and hydrogen were present. Since the universe is a dynamic system undergoing continual change, temperature variations including both high and low extremes certainly did occur. Consequently, given sufficient time, there would occur conditions that were favorable to the formation of proteins and nucleic acids, the building blocks of the life process. As long as there exists the sheerest probability, the "accident" is sure to occur, since the time factor is so incomprehensibly long or indeed endless. This speculation is now verified by the synthetic formation in the laboratory of double viral DNA (deoxyrilbonucleic acid) which demonstrates the initiating of a life reaction. This synthetic genetic material can reproduce a virus in a living cell.

The fact that once there were formed proteins and nucleic acids is all that is necessary to assure the initiation of the life process, the alpha of life. The exact conditions necessary to start the life process from a medium containing the building blocks, proteins and nucleic acids, are not known. The life process is sure however to occur, since the necessary ingredients are there and since there is to occur over almost endless time a variation of environmental conditions that will lead to conditions favorable or hospitable for the initiation and continuance of the life process. If the probability of such conditions were ever so slight but still a probability, the event is nonetheless sure to occur, because of the vast and sufficient length of time.

The earliest known evidence of the existence of life that paleontological studies reveal is in the form of fossils found in rock formations

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that are about two billion years old. These organisms as shown by fossils were alive when the earth was about 2·7 billion years old. From studies of such discoveries, it is concluded that the environmental conditions at that time were quite different than what they are today. The dry land was devoid of life. The atmosphere at that time would not support much of today's life. However, in the bottoms of pools there existed tiny verticle threads of silica formed by living organisms on their upward extremities. There is to be found today a very interesting variety of these same tiny organisms indicating that, without doubt, the evolutionary process of natural selection was already under way two billion years ago, or 1·8 billion years before the appearance of the oldest dinosaurs.[3]

Since the earth had its rudimentary beginning about 4·5 billion years ago, and since it is unlikely that during the first billion years of its existence the necessary conditions for the initiating of life did occur, and since we know the life process had already been under way when the earth was 2·7 billion years old, it is reasonable to assume that the first life reaction, the alpha of life, occurred when the earth was perhaps no more than two billion years old or even some less. That means that the life process on earth could well have been under way for 2·5 or more billion years. As the environmental factors changed, the changes never however reaching beyond the conditions favorable to those supporting life, the life reactions, through the process of natural selection, evolved to that which we witness today. Therefore, life as we have it today is the result of 2·5 billion years of evolution. Continually and persistently does the life process move in a direction that favors its survival. The process of natural selection, being the ability of the life process to adjust to environmental changes, enables the life process itself to survive and endure.

Once the proteins and nucleic acids had formed and the environmental conditions had become hospitable, there was the probability of the presence of the right molecules, in the right quantities, and in the right positions with respect to each other at a time of favorable environmental factors for the life process to exist. The life process therefore was certain to become initiated. Regardless of the low magnitude of the probability of such occurring, the time factor for such a coincidence is so vast that the initiation of the life process was bound to occur regardless of the odds. There was virtually no limit

[3] Natural selection is the adaptation of a life process to changes in the environmental conditions. Through such natural selection adjustments, the process of evolution becomes possible. Owing to endless variations of individuals within a species, a change in environmental conditions will find some individuals more capable of meeting the changed environment than others. Thus the individuals who are more capable of tolerating and accommodating to the new conditions have a greater probability of survival. The features necessary for survival under the new conditions are passed on to new generations by those individuals who survive. Thus is the mechanism of evolution through natural selection.

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to the time that would be needed for that one chance. It did occur and it continues today and will continue to occur so long as the necessary ingredients exist in a congenial environment.

ALL MATTER CONTAINS A LIFE FACTOR?

The transformation that occurred to bring about biotic conditions from the Prebiotic Age was that of providing the necessary physical conditions for the initiating of the life process or reaction, assuming the same elements existed before as after the initiation of the life reaction. The question arises: is there a difference between the elements present in the Prebiotic Age and those of the biotic times to follow? The same question can be asked regarding the difference of the nature of the elements composing an organism before and after death. Any element that is a part of a living organism is indeed the same element once the living organism ceases to live. The very elements that existed in the Prebiotic Age are indeed the same identical elements that compose a living system.

The composition of the atom is material mass and energy. The question then arises: do all atoms possess a life factor and can there be any other explanation for the fact that when certain atoms exist in a hospitable climate the life process begins? The life process or reactions are no doubt catalysed by rays and other forces, but it is not yet possible to show the slightest difference between the atoms that compose a living system and those same atoms when the system is no longer alive. Do all elements of matter contain a life factor that enables the life process to occur when the proper or hospitable environment exists? Another provocative question: has the life process reaction been transported through space from one planet to another, or from one solar system to another, or from one galaxy to another?

Did life arise from common specifications, which, when fulfilled, produce the alpha of life wherever the location, or is there a common point at which it occurred and from which it spread out over the universe?

EARLY LIFE

Exactly when on earth the alpha of life occurred and the very early forms that the life process assumed are not precisely known. However it is known that the life process was already under way when the earth was 2·5 billion years old (two billion years ago) and at that time life probably existed only in pools, since the dry land is supposed to have been devoid of life. The bottoms of these pools contained silica that was deposited by living organisms into vertical

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columns forming mounds. The tips of these thread-like strings of silica contained modifications of a kind of algae that produced the silica. At this same time there were other forms of life existing in such water pools. The oncoming changes in the earth's atmosphere and in the temperature range on earth were no doubt factors that led to the great natural selection process of living organisms which was to yield the many forms of plant and animal life. Some of these are the forms of life still present on earth today. Considering the vast length of time since life began more than two billion years ago, the number of forms of plant and animal life that ceased to continue to evolve and died must have been vast indeed. It is easy to imagine that far more species died and disappeared than those that survived through natural selection down to our time. The species of life about us today are but a fraction of the total number that has appeared.

Some two to two and a half billion years ago life on earth was restricted to liquid pools wherein lived algae-like plants in which the process of photo-synthesis occurred. This reaction was perhaps between molecules of carbon dioxide and water catalysed by light energy and producing sugars, food and energy—indeed the necessities for the propagation of the life process. For the next 1·5 to 2 billion years, life probably remained in the water pools of the earth. The life process was undergoing changes or evolving to meet the changes in the environmental conditions that came about. The overlying factor of natural selection created the guide lines for the course the many forms of life would follow. So long as the life process exists and so long as the environmental conditions change, within the tolerance limits of the life process, evolution is assured and is continuous.

During this long period 1·5 to 2 billion years, when life was restricted to water pools, there is thought to have evolved cone-shaped animals, 10 centimeters long, remotely related to the horse-shoe crab. Since such animals are found through chemical dating to have lived as long as 600 million years ago, and since the atmosphere of the dry land at that time was hot and oxygen-poor, it is concluded that there were some rather highly developed forms of life in the water pools at that time. The fossilized remains of organisms resembling clams called brachiopods are chemically dated as being 0·720 billion years old. From the evidence that exists, the time factor for the first animals with muscular systems and complex skeletons to have developed was well before the Cambrian era which began only 0·520 billion years ago.[4] The fossils of the Cambrian era contain scarcely recognizable plant fossils together with every great animal-type fossil except the vertebrates.

[4] The Cambrian era is the earliest division of the Paleozoic geological period which includes Proterozoic (fossil indications of worms and algae) to the Mesozoic era (fossil indications of the age of dinosaurs or hard-scale fish).

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EMERGENCE OF MUSCULAR SYSTEMS AND SKELETONS

At some point between the time of the initiating of the life process reaction when the earth was perhaps two billion years old and 1·5 to 2 billion years later, life had remained in the water and therein many unicellular organisms developed into complicated organisms with muscular systems and skeletons. Whether this development was gradual over this enormous period of time or whether there occurred at different times abrupt changes of the environment to encourage or hasten the natural selection process is not known. The matter of cardinal importance is a recognition of this event as an accomplished fact and of this there can be little doubt.

INVASION OF LAND BY LIFE

At some point after the occurrence of the more complicated water-dwelling organisms, conditions of the environment changed enough to allow the life process reaction to adjust itself for existence out of the water and in the air. This first invasion of land by the life process reaction was likely in the form of plant life. Chemical dating indicates that this important step in the process of evolution occurred perhaps 0·420 billion years ago (420 million years ago) and was in the form of moss and seaweed cast upon the shores. From these deposits, the process of the development of branches and roots occurred.

For the next 50 million years (0·05 billion years) or up until 370 million years ago, the environmental conditions of the earth allowed abundant growth and diversity of plant and animal life. Compared to now, the climate 370 million years ago was hot and humid over the entire earth.[5] Giant ferns and moss covered the earth land masses and made a habitat for insects and scorpion-type monsters to make their appearance. This era of rich growth dominated by huge insects continued until 300 million years ago and provided a medium conducive to the appearance of reptiles.

ADVENT OF DECIDUOUS PLANTS

As the earth cooled and the surface became dryer and harder, the first seed-producing plants (conifers) occurred and the early dinosaurs appeared about 200 million years ago. Not until 20 million years later, or about 180 million years ago, did the earth cool sufficiently to experience seasons. This gave rise to plants that shed their leaves in winter and remained dormant until the warm season returned. The flowering plants were parallel companions in this ever-changing pattern of evolution. Also 180 million years ago the dinosaurs disappeared, leaving only foot tracks in the rock and ossified bones and eggs as evidence of their existence.

[5] Compared to 500 million years ago, the earth 370 million years ago was much cooler.

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CHRONOLOGY OF EARTH EVENTS

	Duration	*Time ago*	*Earth's age*
	(*Billions of years*)		
Earth's beginning as gas and cosmic dust	—	4·5	0
Formation of minimum density sufficient to support the life reaction	1·0	3·5	1·0
Earth's prebiotic period	2·0	2·5	2·0
Alpha of life on earth	—	2·5	2·0
Life's restriction to water pools	1·5-2·0	1·0-0·5	3·5-4·0
Life's invasion of land	—	0·42	4·0+
Hot and humid growth period on land. Appearance of reptiles	0·05	0·37	4·13
Appearance of first dinosaurs and conifers	—	0·20	4·3
Advent of seasons and disappearance of dinosaurs	—	0·18	4·32

EVENTS AFFECTING LIFE'S ENVIRONMENT

During the 4·5 to 5·0 billion-year age of the earth, there have occurred many different events that no doubt brought about abrupt changes in environment. The cooling off of the earth was not the only factor of change nor was its rate of change necessarily without disturbances and interruptions. This of course means that, in order for life to survive the evolutionary process, natural selection was often diverted from one course and forced to pursue another. In the course of events there were many, many arms or branches of the life process that were unable to adjust themselves to sudden new environmental conditions and consequently died and passed into oblivion. In a sense the process of evolution is definitely a one-direction reaction; that is to say, once a certain high degree of specialization has occurred to accommodate a change of environment, for any sudden change back again to a previous condition the process of evolution is found likely to be irreversible and the system will cease to exist.

CHEMICAL DATING

In order accurately to co-ordinate the age of a life process with events affecting the environmental conditions for the propagation of life, the chemical dating technique is used. Modern chemical dating does enable man today to measure time in terms of today's earth-year unit of time and is reasonably accurate. The fact that many events may have changed environmental conditions and perhaps even the

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length of the earth-year unit of time does not alter the accuracy of chemical dating which depends upon radio-active decay and which is expressed in current earth-year time units. When chemical dating establishes a certain number of earth years to be the age of a specimen, this can be regarded as a reasonably accurate measurement and affords a standard of comparison for the different ages of items. Whether at a particular time in the past billions of years the earth year was longer or shorter than that of today does not alter the relative ages of items as expressed in present earth years.

Chemical dating was at the start a means of measuring accurately the age of any item that once lived and was based on the exact determination of the quantity of carbon 14 present. Carbon 14 (C-14) is a radio-active isotope that loses one electron to become a stable atom of nitrogen. It exists in the atmosphere and in water and behaves in an organism as carbon, that is, it becomes deposited in the bony or fibrous parts and during the life time of an organism it accumulates quantities of C-14 in equilibrium with that in the atmosphere and water. The death of the organism is marked by the start of diminishing quantities of C-14 resulting from radio-active decay of the C-14 content at the point of death. Only when the organism lives is the carbon 14 content maintained in equilibrium with respect to the environment. Therefore, the time from death can be determined if the carbon 14 content is known. The rate of radio-active decay of C-14 to form stable nitrogen is such that one half of an original quantity is dissipated in about 5700 years (the half-life period). The quantity of carbon 14 in air and water is low in the first place. Therefore, at the death of an organism, the quantity is also low and continuously becomes less after death. In 5700 years only one half the original quantity exists. The maximum age that can be determined depends, therefore, on the accuracy with which the diminishing C-14 content can be determined. The practical limits do not extend much beyond 45,000 years.

Other chemical dating methods are not restricted to objects that once lived and to a 45,000-year age. A radio-active isotope of potassium, K-4, decays into an isotope of argon, A-4. A crystalline mineral deposit initially contains no A-4 since its source of argon 4 is from K-4 which is present initially in always the same amount with respect to stable K (potassium). Consequently, assuming that there is no other source of A-4, the quantity of A-4 in such mineral deposits becomes a measure of the age of the mineral. Refinements of such methods have played and will continue to play an ever greater role in establishing the proper and true sequences of material existence on earth and in correlating the numerous environmental changes that were so important in the evolution process of living organisms. Such methods hold promise for establishing accurate age relationships as far back as the first-formed rock deposits, 3·5 billion years ago.

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METEORITES AND COMETS

There is conclusive evidence that giant meteorites, just like those that pock-marked the surface of the moon and that of Mars, have bombarded the earth since its very beginning five billion years ago. Huge depressions well scattered over the earth give lasting testimony to such cataclysmic collisions.[6] Certainly many of these bodies were of sufficient size to have changed the speed of earth around its axis or even to have altered perceptably the tilt of the axis. Such events would have suddenly affected the climate, geology and geography of the earth. These sudden changes would of course alter the course of natural selection pursued by the various life reactions in progress. It can easily be estimated that the earth has been hit at least a million times during its life by meteorites great enough in size to be of significant disturbance to cause geographical, climatic and biological changes. The majority of these large meteorites fell into the oceans and consequently leave no trace discernible on the surface. Very large meteorites such as the one that formed the Gulf of St. Lawrence probably hit the earth on an average of only one in 10 million years. The heads of large comets would also cause similar disturbances.

When large meteorites or comets crashed into the earth, fragments of both the earth and the meteorite or comet were hurled far into space to fall back again onto the earth's surface. These particles were heated to very high temperatures resulting from the impact and from the fast rate of travel through the atmosphere. These particles fused into glass-like fragments known as tektites and are found in areas on the land surface of the earth where such massive collisions have been found to have occurred.

REVERSAL OF EARTH'S MAGNETIC FIELD

From tektites found in southern China, the Philippines and Australia, which all appear to have been produced by the same event, it is concluded that a meteorite struck this area about 700,000 years ago and was perhaps a mile in diameter and probably weighed a billion tons. The time of this deposit of tektites coincides with the time that the earth's magnetic field completely reversed itself. That is, the north and south magnetic poles reversed themselves. Such a reversal is the process of the diminishing of the earth's magnetic field until it becomes zero and then the building-up of opposite polarity. During this process there occurs therefore a period of time during which the magnetic field about the earth is of insufficient strength to deflect away from the surface of the earth the cosmic-ray particles that stream continuously through space.

Although the most recent reversal of the earth's magnetic field occurred about 700,000 years ago, there is evidence that during the

[6] There is evidence that indicates that our solar system contains many meteorites, some as large as perhaps 50 miles or more in diameter.

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past four million years there have been at least eleven such events. The reversal time period appears to be relatively short, perhaps from 2000 to 34,000 years. One of these reversals occurred about 1.9 million years ago, when it is estimated the oldest humanoid creature (*Zinjanthropus* found in Olduvai Gorge in Africa) made its appearance on earth. The appearance and, indeed, the disappearance of many species could well have coincided with the periods during which the earth's magnetic field became diminished through the reversal process. Indeed, the initiation of the life process itself could well have been coincident with a period during which the earth was not so well shielded by a strong capsulating magnetic field from bombardment by cosmic-ray particles. Whether the magnetic field reverses or fluctuates without collisions of meteorites or comets is not known. The fact that the strength of the field varies means that the number of cosmic-ray particles reaching the surface of the earth also varies.[7]

The ocean floor is found to be patterned with strips of rock which are magnetized in opposite directions. These offer strong evidence of the fact that the earth's magnetic field has at times reversed itself. From the strips of the alternately-magnetized rock on the Atlantic Ocean floor, a dependable means is provided for measuring the time over which the South American continent split away from the African continent. This event occurred some 200 million years ago and it is thought that the drifting apart of these two continents continues to occur today at the rate of about two centimeters a year.

THE MOON

The moon, in its orbit about the earth, considerably influences the earth's magnetic field. In addition it is found that the moon deflects and transforms solar radiation directed toward the earth. Alterations of the earth's magnetic field and direct interferences with solar radiation en route to earth both are factors that bring about mutations, giving natural selection more choices in carrying forward the evolutionary process. To what extent the moon over the past could have played an even greater role in affecting earth's environment is not known.

Just as the factor of almost limitless time plays an important role in the probability of the initial appearance of life, so the almost countless changes in the environmental conditions on earth, brought about by both inherent and outside influences, play a most important role in the ever-forward progress of evolution through the process of natural selection.

MAN'S EMERGENCE

The first billion years of our four and one half billion year-old earth was devoted to forming a density sufficient to give it form and

[7] The earth's magnetic field is 70 per cent weaker than it was 2000 years ago.

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position. Some time during the next billion years there accumulated the necessary components to support the life process. By the time the earth was two billion years old it is likely that hospitable environmental conditions for the life process had occurred. Consequently it can be estimated that the first life reaction (the alpha of life) happened when the earth was about two billion years old. This means that the process of life evolution has been under way on earth for at least two and one half billion years.

From the time the life reaction began, when the earth was about two billion years old, until it was three and a half billion years old, the life reaction and the process of natural selection remained in the aqueous liquid pools, since up to then the environment on land was not conducive to the propagation of the life process. Life was able to invade the land areas when the earth was somewhat over four billion years old or about 0·420 billion years ago (420 million years ago). The plant and animal life of the seas spread over the earth's surface. During the past 420 million years, many forms of animal and plant life appeared and disappeared and a few continued to exist through the natural selection process down to this day. The human being is one such form of life. What path did he follow through this long process of evolution? What was he like at different stages in the evolutionary process and how did he happen to survive and to develop into a rational being?

The whole development of the earth as we know it today was a very gradual process, over four and a half billion years in duration. For man, whose life span is less than seventy-five years and whose recorded history is only five to eight thousand years old, the concept of the vast time involved for the earth to have reached its present stage of development is indeed difficult, if not in the fullest sense, impossible to comprehend.

It will perhaps not be possible for one to pin-point the exact time at which the life process began, but once that first life reaction did occur, the evolutionary process was continuous, gradual and irreversible. Certain events may have changed the course of the evolutionary process and indeed did cause many forms of life to cease entirely and often relatively suddenly, but it is also true that those forms of life that survived altered their paths gradually, some faster than others.

The "white" or square-lipped rhinoceros is regarded as an ancient ancestor of the horse. It is believed that this particular species has not evolved or been subjected to pronounced changes brought about by natural selection in over sixty million years. He was highly specialized sixty million years ago and this one segment of the society of rhinoceros encountered no drastic environmental changes and was able to survive sixty million years without having altered profoundly its characteristics. Other segments of the society of rhinoceros were subjected to evolution through natural selection in order to survive.

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Hence, the horse developed from a branch of the rhinoceros family. It took a long, long time and the changes were relatively gradual. The fact that there has been no necessity for change to occur through natural selection in the case of the "white" rhinoceros for sixty million years is indeed unusual.

Some forms of life, such as certain species of shell fish or mollusc, could continue to exist for hundreds of millions or billions of years with little or no alterations, since, for certain species, the environmental changes were held within the easy living tolerance of that species. Consequently we find, especially in the oceans, many forms of life today not much changed from their forms two to three billion years ago. On the other hand, many forms of life were greatly affected by environmental changes and, in order to exist, a process of evolution through natural selection was their salvation.

For example, a sperm whale, a mammal living in the sea, can dive 3000 feet and remain there for two hours or more. He no doubt developed this unusual ability in order to obtain food and perhaps in self-defense. A man so submerged will die in a few minutes; a dolphin will survive only about six or seven minutes. Any whale can also live comfortably in cold water that would kill a man in minutes. The whale's arteries are inside his veins enabling the arterial heat to be immediately returned. The time required by natural selection to bring this feature about was no doubt of considerable duration.

In the case of man's emergence, it was indeed a gradual process and it is probably as difficult to ascertain the time when he ceased to be an animal and became man, as it is to ascertain the exact time that the life reaction itself began.

The early dinosaurs appeared among the vast richness of life on earth some 200 million years ago when the entire surface of the earth was warm, sultry and clouded. About 180 million years ago the cooling of the earth was sufficient to create seasons, an environmental change that brought vast evolutionary changes and new forms of plant and animal life. At this same time the dinosaurs disappeared as did also the enormous insects and many other exotic forms of life of that era. At this point in the long steady process of natural selection, was man still a creature of the seas or was he a land animal? The chain of natural selection traces itself back all the way to that very first instant when the proper molecules got together in an environment hospitable for the alpha of life. Consequently, it may be presumed that man was present in some form of development since the very beginning of the life reaction. Just where man was and what he was at this eventful time 180 million years ago may never be precisely known; nor is it indeed necessary to know such details in order to acknowledge that man did exist in some living form and indeed even at the very beginning of life. His development has been an uninterrupted chain of events since the alpha of life.

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IRREVERSIBILITY OF EVOLUTIONARY PROCESSES

The number of forms or species of life that has appeared only to disappear over the long history of life on earth is so vast that it challenges comprehension. For example, there are today remaining on earth only five species of the rhinoceros. They are the last offshoots of the odd-toed ungulates that at one time, millions of years ago, were very numerous over the earth. These remaining five species are rapidly disappearing, as have countless other variations of ungulates done over the eons of time.

The process of evolution simply does not reverse itself but continues in one direction until it is forced to stop, owing always to a condition it confronts to which it has not time to adjust or accommodate. The cessation of a species to exist can be sudden instead of gradual. A current example is the passenger pigeon of North America. In this instance the appearance of the European man on the North American continent was an environmental factor that the passenger pigeon could not overcome. These migratory birds were sought after for their food value, feathers and supposed medicinal value of certain of their organs. There were countless millions of these migratory birds as late as 1870. By 1900 the last free passenger pigeon was shot by man.

The orang-outang is also rapidly disappearing, as is also the komodo dragon or lizard living on three small Indonesian islands. The dugong or sea-cow is also facing rapid extinction. These current events bear witness to the much-repeated pattern through which the life reaction has relentlessly passed.

ANTHROPOIDS—MAN AND HIS RELATIVES

There are today creatures that are no doubt related to man. The anthropoid or hominoid are names assigned to humans, chimpanzees, orang-outangs and gibbons for the reasons of anatomical similarities. The fact that all primates possess myoglobins that behave identically indicates that all of the so-called primates have a single common origin or ancestor. Myoglobin is the oxygen carrier of the muscle tissue which provides the fuel for muscle contraction. The myoglobin of a primate is found to be different from that of other forms of life. The myoglobin of primates has changed very little over the many millions of years compared with the changes that occurred in other proteins that chemically animate us. This chemical identity common to all primates suggests that all primates have had a common ancestor or origin. The different primates that survive today are therefore branches from the main stem that leads back to a common trunk.

THE PROGENITORS OF MAN

Discoveries of fossils of early primate-type creatures usually raise questions as to whether or not the specimen represents an

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actual progenitor of man. Monkeys, apes, gorillas, chimpanzees are various branching offshoots of a common ancestral stock. How far back man's ancestry can be traced is of vital interest because such knowledge throws light upon the course of evolutionary natural selection through which man climbed his way. The progenitors of man were not monkeys and they were not apes. The progenitor of man had characteristics different from the progenitor of monkeys or that of apes. The knowledge of pre-man and early man is the bridge that is sure to teach man more than he has ever before known about himself, how he came to be, where he is, and what characteristics made him what he is.

There are fossil remains of primate-like creatures thirty million years old, but whether these creatures were direct forefathers of man or one of his ape or monkey "cousins" is perhaps never to be known with certainty. It is now revealed that roaming the lake shores of western Kenya in Africa some 19 million years ago were direct ancestors of man—*Kenyapithecus africanus* and *Kenyapithecus wickeri*. At least these were animals that were traveling a natural selection route separate from their closest "cousins" the apes. The forking process, the greatest of all events in the evolution of man, had already taken place in Equatorial Africa, according to the belief of many. Following this event, man's forefather started to make his own road map, different from all others, including his "cousins" the apes.

There exist very few fossil remains of pre-man or early man since he did not bury his dead. The dead were allowed to lie, the decaying flesh being eaten by the vultures and the bones being consumed by hyenas or otherwise disintegrated.

There were no doubt many branches that struck out from the main stem only to wither and die, passing into oblivion. The main stem, however, continued to prosper and evolve, finally forking itself into separate species some of which survive today and, of course, one of which is man. What that predecessor looked like or just when he existed immediately before the forking occurred is not definitely known, but certainly the fact that such a creature did exist can not be doubted.

That common ancestor to both man and ape could have lived as long as 40 million years ago and it is believed evidence of his existence might some day be found in Egypt's Fayum province. A skull about 10 cms. long and 4 cms. high of a primate called *Aegyptopithecus*, which is thought to have lived 28 million years ago, was found in the Fayum desert south-west of Cairo. Whether or not this fossil of a primate represents the common ancestor of man and ape is not precisely known. If his position on the evolutionary trail is before the occurrence of the fork where man's ancestor took a different path, then he could be the forerunner of both man and ape.

It is known that a man-like creature lived about two and a half million years ago in Equatorial Africa along with mastodons,

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hippopotamuses, elephants and saber-toothed tigers. He was perhaps five feet tall, walked erect and had human-like teeth, a small brain and a large jaw. How did this particular creature survive the previous tens of millions of years in such a hostile environment? He had not yet acquired the capability to produce and use weapons forceful enough to overcome the attacks of such formidable foes, and certainly all of them could out-run him. One reason given is that his flesh was of very bad taste and odor. Only if such a predatory animal was desperately hungry could it endure the bad taste and odor of this pre-man's flesh. How, somewhere along the long trail of evolution, man acquired a flesh possessing an unpleasant taste and odor especially to other predatory animals, may never be known. It is possible that, through radiations from outer space especially during periods of minimum polarization when the earth's protective magnetic fields were at a minimum, there resulted mutations in very vast numbers. Given an almost limitless number of possibilities and indeed periodic long periods of no or minimized magnetic shield, the probability factor can explain a mutation resulting in flesh of a particular species becoming obnoxious in taste and odour to other existing predators. Natural selection would of course preserve this important property, since it was a means of survival.

Evidence now exists that from two and a half down to one million years ago there probably co-existed several man-like products of the evolutionary forking process. Certainly the predecessor of man himself and that of the ape family co-existed and there is evidence that at least one other ape-like creature existed—an evolutionary sideline. This creature differed from the direct ancestor of man in that he was a vegetarian. (The direct ancestor of man was a predatory meat-eating animal). This vegetarian "cousin" of man's ancestors is called *Australopithecus robustus*, had large jaws, and used his molars to grind nuts, roots and to masticate fruit. A long ridge existed on the top of the skull providing solid anchorage for the powerful jaw muscles.

The predecessor of man (*Homo habilis*), who lived at the same time as the vegetarian *Australopithecus robustus*, was by contrast a hunter who by this time had developed thumbs that provided a precision grip allowing him to fashion and use crude tools from stone, bone and perhaps other materials. At first he probably learned that he could use to an advantage sharp-edged stone that he found. The next step in his advancement was perhaps learning that he could create a sharp-edged stone by knocking two stones together.

During all this experience, there was evolving, through natural selection, thumbs that gave him an ever-better grip. These first steps in the preparation of pre-man to become man were most important and no doubt took vast periods of time during which plateaux of development retarded progress and no doubt many attempts failing before a success was irrevocably won. In excavations dating two and

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a half to one million years ago are also found indications that pre-man fashioned a crude hut as indicated by 15-foot circles of dark stones.

It can be concluded therefore that two and a half million years ago there co-existed in Africa the predecessors of the apes of today, the predecessor of man (*Homo habilis*) and the *Australopithecus robustus* (sometimes called *Paranthropus*) who was the ape-man vegetarian. The ape-man vegetarian disappeared and the question of what happened to him provokes answers that can tell much about the characteristics of pre-man and hence man himself.

Fossil discoveries in Africa—Swartkrans near Pretoria—indicate that about one million years ago Homo Erectus, who probably was a direct descendant of *Homo habilis*, was the forerunner of modern man. Compared to his "cousin" who was the descendant of the ape-man vegetarian, he was more nimble, quicker witted or more alert and could fashion crude weapons. He was hairy, stooping and perhaps dark-skinned. The ancestors of the monkeys, gorillas and so on, were still primarily dwelling in trees and were not in direct competition with *Homo erectus* and *Paranthropus* (also called *Australopithecus robustus*), the vegetarian ape-man, both of whom were now dwelling on the ground.

It is entirely possible that the vegetarian ape-man became a competitor of *Homo erectus* for space and food. The food for *Homo erectus* was for the most part small animals such as deer rodents, frogs, which in turn ate bulbs, roots, berries and the like. These small animals ate food that was, in part at least, the same food eaten by the vegetarian ape-man. If animals as food were to become scarce for *Homo erectus*, it could well have been a result of not enough vegetable matter for both the small animals that constituted his diet and for his ape-man "cousin." Regardless of the reason, *Homo erectus* waged an uncompromising war against *Paranthropus*, the vegetarian "cousin." A drought could have, for example, brought about the conditions making survival between pre-man and ape-man a contest to the death of one or the other.

A struggle for survival did take place, as evidenced by the findings of fossils. The fact that *Homo erectus* was a predator caused him to become more alert than his vegetarian ape-man "cousin." From his alertness came an intellectual evolution that enabled him to fashion crude weapons which also accounted for the development of a thumb and hand possessing dexterity. The fact that he was primarily a predator also caused him to be able to move swiftly. All this was in contrast to his "cousin," the vegetarian ape-man (*Paranthropus*) who was, by comparison, sluggish and clumsy. The vegetarian did not need to develop a highly sensitive alertness in order to obtain nuts, berries or roots to eat. He had no reason to develop tools in order to obtain his food. Therefore, he retained those characteristics which were adequate to supply his needs.

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A change in climate could well have accounted for the fact that food of all sorts became scarcer on the plains of the African Transvaal. Thus a struggle for survival could have been a cause for all sorts of battles among the earth's living creatures. Whatever the reason, there could have occurred about a million years ago a struggle to the death between *Homo erectus*, the direct ancestor of man, and his then living "cousin" the vegetarian ape-man. The contest was one-sided as is evidenced by the fact that fossils show *Homo erectus* using fangs from a leopard's jawbone to fashion a weapon with which he could wield a murderous killing force penetrating the *Paranthropus*' skull. This was perhaps the last real challenge *Homo erectus* had to experience. There was by this time no other living creature that had a real potentiality to surpass him, and even then the *Paranthropus* offered not a very severe challenge since he really had no defense against a more highly evolved psyche.[8] From this point forward *Homo erectus* was the indisputed master of the animal kingdom. Once the evolution of his psyche had reached this level, it was to continue to develop and his real competition would be found within his own species rather than from another. His future with respect to dominion over other living specima was assured. From this point forward the process of evolution through natural selection concentrated itself more on the psyche of man than on his physical characteristics.

THE ADVENT OF MAN

The Java Man and the Peking Man, who lived 400,000 to 500,000 years ago, were probably direct descendants of *Homo erectus* who overcame the vegetarian ape-man in their struggle for survival. Anatomically, the *Homo erectus* of one million years ago differed not greatly from the Java Man or the Peking Man. However, these later types of early man certainly possessed higher psyches developed through the process of evolution.

The transition of the pre-man specimen to what can be called man was gradual over the past million or more years. It is impossible to pin-point this transition and designate a specific time before which the species was pre-man and after which the species was man. Yet it should be possible to define certain characteristics that would identify man and then it could be stated that this species became man when it possessed characteristics that are peculiar to man alone. The all-important characteristic that is singularly peculiar to man is the development of his superior psyche.

The acquisition of the ability to make crude tools or weapons by pre-man was certainly an advantage he had over his "cousins," but it did not mark him with a characteristic entirely separate from other

[8] The word psyche is used here to refer to the mind and its ability to function as an independent thought and reasoning center. Its development is regarded here as physiological and physical.

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mammals or life forms. Certain birds (Galapagos woodpecker finches) have the ability to use a small twig to rout insects from their holes in wood. Other birds (Egyptian vultures) are known to use stones to throw or toss at ostrich eggs in order to crack open their tough shells. Chimpanzees use rocks to crack open hard shells containing food and they use sticks to feed on ants. They also use leaves for drinking vessels and to wipe their bodies. Sea otters employ stones to crack open shellfish.

Perhaps it can best be said that pre-man became man when he became conscious of himself or of his own existence. Within himself he became aware of the fact that he was living and of course with that consciousness came awareness of the surroundings. Man *knew that he knew* he was hungry, while pre-man only *knew* he was hungry.

EVOLUTION TURNS TO MAN'S PSYCHE

From this point of consciousness forward the evolutionary emphasis became placed on the psyche rather than on the anatomy The anatomical aspect of man was already well developed and to a remarkable degree of perfection. The body was ready to serve well the natural selection process that was to center its attention in the evolution of the psyche.

HIGH PSYCHE—SURVIVAL FACTOR

Just as *Homo erectus* was able to overcome and eliminate *Paranthropus* because he had a higher-evolved psyche, so did the earliest man or group of men find it necessary to have always a higher psyche than his competitor in order to survive. This was of course true when, for numerous reasons, the food supply might not be adequate for all. He who was able to defend his food supply against other intruding men, not by simple physical strength but by throwing a stone or wielding a club or fashioning a new and more effective weapon, would survive over his adversaries. Under these circumstances, natural selection, through the use of the psyche, became dominant over natural selection concentrating mainly upon the physical anatomy.

For example, if one group of early men reasoned that collective defense against single intruders always placed the odds of survival on the defenders, then the defenders acting collectively would destroy the intruders who had not reasoned other than to act singularly. Under these circumstances, if there were not enough food for all, it is obvious that the men with the psychic capacity to defend collectively (superior intellect) would soon cause the others to starve. Thus is the manner of the evolution of the psyche. It has been for a million years and still is the principle factor at work in the evolution of man. Those who survived and who will survive were and will be respectively those with the intellectual power or psyche superior to their adversaries.

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That group of men over the past million years who could, by virtue of their intellect, invent or discover a new means of defense or a new means of aggressively acquiring food, were the ones to survive. The competition between individuals within a group or a society of men was likewise keenly fierce. Only those individuals with superior intellectual qualities survived. Natural selection proceeded in a way to destroy the intellectually weak individual, ever favoring the intellectually superior individual even though the physical characteristics were well matched or even superior.

The struggle for power on the part of the single individual as well as on the part of the group that formed the societies of man became the principle quest of man. Unless he possessed superior physical and intellectual power, he or his group was sure to be eliminated by his fellow creatures. This perpetual struggle for existence led unmistakably to a higher and higher development of the psyche, making inventiveness a necessity. The ever-existing necessity to overcome his competition is the very keystone to the evolution of man's psyche. The capability to survive over his fellow creatures and his ability, aided by psychic development, to adjust to any environmental changes became the never-ending struggle of man. Survival over adversity was the force that kept the psyche advancing. Whatever means that was devised which made survival possible was another step forward in the evolution of the psyche.

HIGH PSYCHE—QUEST FOR POWER

It becomes therefore a natural reaction or trait of man to use his intellect not just to defend himself but to acquire things he wants, such as food, *Lebensraum*, and all the components comprising status and wealth. To accomplish these desires, he must acquire possession of that which he does not have and which he needs for his purposes. Often he must overcome or overtake any others who may stand in his way. Under these circumstances only the intellectually strong survive. Without such struggle, the intellectually weaker would not be eliminated and the weaker would merely dilute and pollute the stronger. If the psyche of man is to continue to evolve ever higher, there must be a natural selection giving the stronger individual the odds to survive. This is a fundamental law of all life processes and must be fully comprehended if man is to progress and become ever more the pilot of his own destiny.

The fate of the Amerindians of North America is an example of what can happen to a human society that suddenly experiences a change in the environment to which the individuals cannot adjust. Although there were at times struggles for food between the tribes, there was no threat of total extinction by a psychically more sophisticated competitor until the White European appeared. The process of natural selection dictated that the aborigines would perish or lose

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their identity in the face of the more sophisticated, higher developed psyche of the modern European.

The contest of survival through the demonstration of superior force or might is as natural to man as the heart beat to any mammal. There is no indication that this fact is less important now than it was a million years ago when he first became man. As a matter of fact this very struggle accounts for the very evolutionary development of his psyche that has produced the present highly advanced civilization.

HIGH PSYCHE—SATISFACTION OF CURIOSITY

With the advent of man's consciousness, he acquired a property not possessed by other living creatures. Thus the stage was set for the gradual and sometimes painfully slow development of his psyche or mental capacity. With every new step forward in his awareness of himself and his surroundings, the one that followed perhaps required less time. The ones who advanced more rapidly were able to find time for the satisfaction of curiosity. The satisfaction of curiosity became, therefore, a driving force in the expansion of man's knowledge and the organization of thought. Great periods of time must have elapsed wherein man was so busy merely keeping himself alive that his physical and meager mental capacities were entirely consumed in this one task. Little by little however, he was able to free himself sufficiently to allow for further discoveries and greater mental development.

Chronology of Life Events	*Millions of years ago*
Advent of life on land	420·0
Appearance of reptiles	370.0
Appearance of dinosaurs and conifers (Separation of African and South American continents)	200·0
Advent of seasons and disappearance of dinosaurs	180·0
Appearance of common ancestor of ape and man	>40·0
Existence of primate-like creatures	>30·0
Appearance of progenitor of man, *Kenyapithecus africanus* and *Kenyapithecus wickeri*	>19·0
Coexistence of descendants of progenitor of man:	
1. *Homo habilis*—predator and predecessor of man	
2. *Australopithecus robustus* or *Paranthropus*—vegetarian	
3. Predecessors of ape family	2.5-1.0
Appearance of *Homo erectus*, descendant of *Homo habilis*	1·0
Disappearance of *Australopithecus robustus* or *Paranthropus*	1·0-0·5
Appearance of Java and Peking Man	0.5-0.4

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Thus man as *Homo erectus* emerged presumably as a descendant of pre-man, *Homo habilis*, a carnivore and predator. This event is said to have occurred about one million years ago. He acquired awareness of himself and of his surroundings or environs. Through the process of natural selection man's superior psyche has made him master of all creatures and has given him the ability to adapt to environmental changes by means of inventive capabilities. Thus the play of chance in effecting man's adaptation to change is diminished.

INSTINCTS AND TRAITS

The process of natural selection prescribes the evolution of living subjects not only by bringing about physical changes in the individual but also by accounting for the very important development of mental capacities (psyche) through the acquisition of instincts, behavioral traits and, later, awareness and reason. The behavioral patterns of living creatures are founded on instincts passed on from one generation to the next resulting in characteristics or traits peculiar to a species or individual. It is important, therefore, to consider the mechanism of evolutionary inheritance in order to provide a basis for the understanding of the development of these attributes of the psyche.

Konrad Zacharias Lorenz of the Max Planck Institute, in discussing evolution and modification of behavior, defines adaptation as the process which molds the organism so that it fits its environment in a way to achieve survival. He states that adaptation can occur in two ways: one is by natural selection which is a chromosome function and the other is accomplished through the interaction between the individual and its surroundings or the influence of environment on the individual. Reflexes, releasing processes and all orientation responses are a result of environmental sources of environmental learning or information. Information acquired by an individual as a result of environment can be acquired as an instantaneous response to impinging stimuli which orient it in space and time. The processes of heliotropism, chemotropism, electrotropism and so on, of the simpler organisms are examples. It is noted, however, that these environmental adaptations in no way change or alter the machinery of the individual's behavior and consequently are not necessarily a manifestation of learning. For example, unicellular organisms often respond to such environmental stimuli but they do not learn. In higher organisms on the other hand such stimuli often produce learning but they remain independent of learning. When learning is produced by the organism, storing of information in some manner is implied. Such storing capacity, however, is quite likely inherited.

Mixtures between the chromosome function producing natural election and influence of environmental factors are regarded by

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Lorenz and others as both playing roles in the behavior of organisms. The adaptation of organisms can be then owed to both processes. The American psychologists' view that all learning and adaptation is the result of environmental influences entirely and not owed also to inheritance is discredited by citations of behavior activities of organisms where the animals were raised under circumstances that withheld particular information under investigation; yet these animals demonstrated possession of the information showing the source was that of inheritance.

CHROMOSOMES—PROGRAMMING MECHANISM FOR INHERITANCE

Natural selection is made possible by variations which are found between individuals of every generation of every species. These variations, though usually slight, are sufficient to enable evolution to occur slowly through the inheritance of changes in the chromosomes. The chromosome is made up of a large number of complicated self-reproducing molecules called genes. These genes are arranged in linear fashion forming a filament. The genes forming the chromosomes are thought to be fastened one to the other or are affixed to a fine fiber which holds them together. Chromosome images obtained by applying a new technique (scanning) to the electron microscope are so revealing as to imply the existence of an underlying basic structure holding the gene distribution making up the chromosome.

The ordinary cell division or mitosis requires that each filament of genes (chromosome) must double itself prior to mitosis. Upon division of the cell, the doubled filament is pulled apart in such a way that each of the new cells contains the same chromosomes as the initial cell. In the case of an immature germ cell (reproductive cell) that still has before it the last division required to become a mature egg or sperm, the chromosomes inherited from one parent line up with the almost identical chromosomes from the other parent. This attraction of homologous chromosomes is called synapsis and is thought to be owed to an attraction between similar genes present in both chromosomes. The synaped chromosomes are pulled apart again in such a way that the final cell division results in mature germ cells (reproductive cells) each of which contains only one each of the previously paired genes. Consequently, specific assortments of genes are conveyed to the off-springs and these genes, interacting with themselves and with outside factors of environment, such as radiation for example, become the programming elements defining the course of the development and the specificity that gives different characteristics to individuals.

That a person's behavior and intelligence can be and no doubt are related to the inherited chromosome complex of his genes is becoming more and more recognized. Recent statistical studies indicate that persons engaging in violent and criminal acts may be behaving in

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such a manner because of an inherited genetic tendency for such behavior. Normally a boy is found to obtain a female X chromosome from his mother and a male Y chromosome from his father; and a girl obtains a female X chromosome from both her mother and father. With respect to inherited chromosomes, therefore, an XY male and an XX female are normal. For unexplained reasons, males with XXY chromosome complexes occur. These individuals, though male, possess recognizable female-like behavioral characteristics. Many are found confined to mental institutions and jails. Abnormal males of the XYY type are recognized as also occurring, perhaps with a frequency of one in every 300 or less males. In addition, these "super males," possessing a tall stature and a pimply complexion, are mentally below normal and are frequently found to be criminally aggressive from the age of ten.

The cell nucleus contains in addition to chromosomes certain complicated molecules such as deoxyrilbonucleic acid, referred to as DNA, and ribonucleic acid, RNA. These compounds are thought to be basic components of genes and consequently contribute to the hereditary characteristics possessed by genes. A DNA molecule is of majestic proportions and is just discernible with the electron microscope. Its complexity is so vast that it can and does contain the "code" governing the forms of life. The number of paired bases of the DNA molecule varies from about 5000 for a simple virus to perhaps five billion in the 46 chromosomes of man. The human DNA molecule is compacted into tightly twisted turns and can be five feet long, yet contained in one microscopic human cell. This is the component of living organisms that determines the form of life. It is therefore truly one of the basic building blocks of life. A fully biologically active DNA virus is said to have been produced synthetically. This synthetic genetic material can reproduce a virus in a living cell. Since a virus is a simple life unit consisting of DNA and capable of reproducing itself, it can be stated that a simple life reaction has been synthetically intitiated. Thus such a discovery becomes a milestone in man's ever-increasing ability to control and guide his destiny. It is thought that this accomplishment of synthesizing a simple tiny virus which attacks bacteria inhabiting the human intestinal tract is but a short step away from the actual manipulation of genes. This means that man is within easy grasp of the ability to regulate or to formulate hereditary characteristics of both a physical and psychic nature. Man's intelligence as well as his physical characteristics are within sight of being formulated by man himself. Such power will allow man to make a blueprint of his future generations.

RNA or ribonucleic acid can be made to duplicate itself when placed in the presence of the enzyme replicase. In this manner it has been possible to study virus strands of RNA outside the living cell. By altering conditions, only the faster reacting strands were allowed

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to survive. Thus a natural selection process was created and specific strands survived that seem to contain no genes that call for cell infection. This observation appears to have potential medical value as a possible means of destroying disease-causing viruses.

Thus the window, through which can be seen the manner by which the vast and ever-occurring variety of individuals is created, becomes ever larger. This wide variety of individuals allows the process of natural selection to sort out the changes that are responsible for hereditary evolution.

All living cells contain those chemical entities called genes, whose appearance through evolution occurred in the very earliest time of the life process. There are said to be three million genes in each living cell, and in the case of man, it is estimated that there exist perhaps as many as 10,000 different kinds of genes. The gene component of a cell, together with all the genes of all the cells making up a particular organism, determines the structure of the organism and, indeed, its mannerisms. They constitute the molecular code system that defines the structure and indeed the behavior of living organisms. The genes comprising a living unit can reproduce themselves in that living unit as the cells multiply and they act not as individuals but as a coordinated group for the whole living unit. Thus no one gene of a living unit can be modified without all genes of that unit being affected.

The question as to whether or not all cell nuclei of an organism contain a full complement of chromosomes and genes containing all the necessary information to reproduce an identical twin has been one of considerable biological significance. There are those who have maintained that only the cell nuclei of reproductive cells contain the full complement necessary to reproduce an identical twin. Those sharing this view regard cell nuclei other than those of reproductive cells to contain only the specific chromosome information to function as a component of the heart, liver, and so on, as the case may be. Thus it is maintained that specialized cells derive their specificity from the fact that they contain only the information required for their selective function. There is however some evidence that could indicate that all cell nuclei of an organism do contain a full complement of chromosomes and genes with complete information to reproduce a whole identical organism. It is claimed that 30 per cent of highly specialized intestinal cells of frogs removed from one frog and placed inside a frog egg whose nucleus had been destroyed will develop into polliwogs or whole frogs. This observation suggests that, since each cell nucleus can contain a full complement of chromosomes, there is perhaps a chemical factor that renders all aspects of the nuclei chromosome complex dormant except that part that provides the specificity for that particular cell function. This of course allows for the speculation that, if this theory is proved true, it becomes possible to mass-produce identical twins. In the case of

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people, physical features and indeed even mental abilities and capacities could be produced as desired.

MUTATION—A CATALYST FOR NATURAL SELECTION

If the character of a gene in a reproductive cell is altered in any way, a very marked change in the descendant organism can occur. This sudden, noticeable and often severe change is called mutation. The prime cause of mutation seems to be the bombardment of a gene by radiation particles. Radio-active materials are a source of radiation that causes mutation. Cosmic rays, ever reaching us from outer space and in higher concentration when the earth's protective magnetic field is at a minimum resulting from the reversal of the earth's poles, are a serious and continuous source of radiation that also causes mutation. Radiation, therefore, though most often very dangerous when an organism receives a severe concentration, is the chief factor for causing variations among individuals of species and is therefore the underlying agent that makes evolution possible.

Most mutations are not congenial to the environment and are discarded by the process of natural selection. The odd mutation that by chance is not detrimental but instead meets a condition which will withstand a new environmental factor is the one naturally selected. Thus there can be caused a phenomenally rapid and decisive step in the progress of evolution.

GENETIC NATURE OF INSTINCTS AND TRAITS

The evolutionary process can be traced through fossils and many changes in the physical structures of organisms are observed. We can observe the present human body in comparison with bodies of man's predecessors, reconstructed from fossilized bones. Indeed we can in a few generations observe physical evolutionary processes in many living organisms. Overlooked and unexplained is the study of evolution with respect to the psyche. This involves a consideration of the instincts and behavioral traits of animals.

The gene components of an organism specify the characteristics of the psyche as well as the physical characteristics of the body. The evolution of the psyche, giving rise to the traits and instincts, is without doubt the most important contributing factor to the understanding of the nature of man and his behavior. Yet it remains perhaps the least known, least studied or understood of all knowledge. The traits or habits of animals resulting from inherited instincts are carefully blueprinted or programmed in the complex gene components of the living cells and provide the means by which the psychic factors as well as the physical anatomical components are passed on from generation to generation. For example, Pavlov found intelligence differences between different breeds of dogs. He regarded such differences as owed to genetics or previous experience

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or both. He found salukis, whippets and terriers to be "weak," whereas basset hounds and St. Bernards were "strong." Interestingly enough he found that mongrels fell between these groups. The "weak" were difficult to train and became abnormal and ill. He divided the "strong" into two groups, those that learned to perform responses easily and those that found the development of inhibitions more difficult. It is only logical that some traits and instincts are common to many species of animal life including the human being (*Homo sapiens*). Unfortunately studies on human inborn or instinctive behavior are few indeed.

DISCOVERY OF FIRE ALTERS BIOLOGICAL CLOCK INSTINCT

As an example of an instinctive trait common to many animals, the so-called biological time clock mechanism may be cited. The 24-hour day-night cycle provides an environment to which all animals subjected to it must adjust. In other words the process of natural selection was forced to take this light-dark 24-hour cycle into account when carrying out the evolutionary process. In the case of primates, for example, there developed within the organism a kind of clock mechanism which can be regarded as an instinct that tells the individuals when to arise in the early morning and when to return to their shelters or nests at nightfall. This time clock instinct became to the monkeys, apes, and other primates living in the wild state near the equator, a trait or habit which finds them following a 12-hour wake period and a 12-hour rest period. This has become such a part of the primate's make-up that he instinctively is compelled to follow this routine. This was also true of man up to some 300,000 years ago when it is believed he discovered how to create fire and use it to his advantage. Besides keeping him warm and cooking his food, fire gave him light when darkness of night fell around him. The discovery of how to create fire was a discovery that altered the emphasis of the importance of the biological clock that had, over the eons of time, been installed in the organism through or by the process of natural selection. The 12-hour on and 12-hour off mechanism became to early man a kind of protective device enhancing survival. At night, when he could be the easy prey of other predators such as cats, snakes and the like, his built-in clock mechanism kept him confined to the relative safety of his nest or lair. Similarly, this same built-in clock mechanism kept him awake and alert during the day when the animals supplying his principle diet were also about and visible to him.

With the advent of the discovery of fire, the built-in biological timing device was not as useful or advantageous to his survival as before. Rather than resting the entire night, he would find it necessary to arouse himself periodically to keep the fire burning. The light from the fire provided the means by which he could carry

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out certain activities at night when his built-in biological clock would have had him sleeping. The warmth combined with the light of the fire enabled him to be comfortable in carrying out certain pursuits during the night, when before he learned to use fire, it was too cold. The presence of fire was a decided deterrent to animals that jeopardized his safety. It was as safe or safer to be by his fire at night than to be secluded in his nest.

From, therefore, the time of the discovery by man of fire some 300,000 years ago, natural selection de-emphasized the importance of the built-in clock instinct in the case of man. Since then natural selection has freed man from much of the dictates of the biological time clock. Consequently, today, one of the differences between man and other primates is the fact that man's built-in biological clock is not nearly so pronounced an instinct as it is in the other primates. In the case of man, the invention of fire represented an important step in the evolution of the psyche. The evolution of the psyche allowed man to control the environment, whereas before, he was completely dependent upon the evolution of his physical make-up to adjust himself to the environment. It is interesting and important however to note that, after 300,000 years, there still remains in man strong traces of this clock instinct. Those who travel today very rapidly and in a matter of hours reach a destination where the customary night hours are reversed with daylight hours, find that a period of days is required for their built-in biological clock to adjust to the new environment. The 24-hour pattern of body temperature fluctuations are thought to be owed to that instinct that manifests itself as a biological clock.

It can be said, therefore, that, in addition to providing heat for cooking and warmth, the discovery of how to create fire brought to man light into his darkness. This new environment was a stimulus to the process of natural selection which in this case was a step toward freeing man from the dictates of that instinct regulating strictly or synchronizing precisely his habits and behavior with the 24-hour cycle of lightness and darkness. Even after 300,000 years, however, manifestations of this instinct still remain and are no doubt factors that can help account for many features of man's behavior, if they were fully understood.

SOME INTERESTING INHERITED INSTINCTS

Another animal trait manifests itself as a built-in compass that provides a sense of direction enabling the animal to move toward a particular location. It is possible that this trait is developed from an instinct based on the position of the animal with respect to the magnetic fields of the earth. Birds that manifest this trait in the natural state or in wooden rooms do not display the trait when in a steel room. The steel neutralizes the effect of the earth's magnetic

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field. Other forms of life that are known in some way to respond to magnetic fields include snails, flatworms, paramecia, fruit flies and certain beetles and algae.

The ability of bats to avoid colliding with objects while in flight even though they are blind is a trait that finds its basis in a built-in kind of radar whereby sound waves bounced back from the surface of objects reveal their location. A special kind of hearing device is thought to explain the trait of a woodpecker whereby it knows the location of insects hidden well within wooden poles, trees and branches. This special sense of hearing is thought to guide his drilling with his beak.

Earth-worms secrete a mucous substance from the entire surface of their bodies. In addition to providing a lubricant that assists locomotion, this mucus also serves as a binder for dirt particles, thus serving to cement the surface of their burrows. It has been discovered that under circumstances of an electric shock, pinching or handling, the mucus undergoes a chemical change whereby it contains a substance called pheronone. This additive is thought to provide a means of warning to other worms. When dried, the mucus containing this additive remains an effective deterrent for other worms for a period of three months.

MAN'S INSTINCTS ANTEDATE MAN'S EMERGENCE

The observation of animals in captivity is no reliable way of studying their natural instincts or habits. To make such studies the animals must be observed in the wild state. In a zoo, for example, the animal is not required to seek out his food. Therefore, his entire warehouse of instincts that, in the wild state, provide him with cunning and the action (challenge) necessary to fulfil his food needs, are not practised, and cannot be observed and thus remain unknown. If artificial light is used at night to make observations in captivity, there occurs a disturbance of the natural biological timing mechanism and the true performance of animals as they behave in nature is never found out. Yet those instincts are there and they comprise as much a part of the organism and its behavior as do the various physical parts making up the anatomical composition.

We are continually being reminded that we must learn more about man. Unfortunately such statements usually fall short of suggestions regarding what knowledge we should seek and where we might learn what. One such statement pleads for the solution to "the mystery that can turn creative energy into brute force, a peaceful crowd into a mob, and an ineffectual weakling into a mass murderer." This statement alone is made up of contradictions. Can a mass murderer actually have been an ineffectual weakling? Can a mob have truly been a peaceful crowd? Is it possible to distinguish between brute force and creative energy? Does not this statement

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itself suggest that perhaps instinct or traits of this very nature are true components in the make up of man?

Indeed, if man is ever to be understood, his behavior characteristics must be approached from the view of the true manner in which he acquired them—through the evolution of the psyche. There are to be found traits and instincts in living organisms that trace themselves back beyond the countless forks of the branches to the main stem or trunk of the tree of life. Consequently, it follows that many instincts found in many animals are shared by man. Some of these instincts may, in the case of man, become modified or minimized. For example, the biological clock instinct in man is today modified and less pronounced compared with that of the chimpanzee or baboon in the wild state.

There are also no doubt many instincts common and prominent in both man and animal that explain many behavioral characteristics of man that are in every other way completely lacking in explanation. It behoves one, therefore, to study the performance and behavior of all living organisms and in the wild. Only in the wild state do the instincts become clearly manifest. The knowledge of instincts so learned will no doubt go a long way toward recognizing man's own instincts. Such studies and observations should provide windows through which man can better be understood. The psyche of man evolved as did his body. Just as we have hair that was probably once scales, and limbs that were probably once fins, we have traits that are derived from deeply programmed instincts which to a great degree govern our conduct and which trace themselves back just as far as the scales or fins.

Many characteristics in the form of traits that man possesses are as prominent a fixture to our psyche as our nose is to our face. Not until this fact is recognized and studies and observations of these components made will there be a realization that the evolution of the psyche is by far the most important factor in the further development of man. It is this aspect of man's evolution that determines his future and accounts for his domination over other forms of living organisms on earth.

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Book Reviews

NEGRO AND WHITE CHILDREN: A PSYCHOLOGICAL STUDY OF THE RURAL SOUTH.

By E. E. Baughman and W. G. Dahlstrom. Academic Press, New York, 1968. Pp. 572. Price $15.

Negro and White Children is a research study in a series on social psychology that includes monographs, treatises and texts. The book is replete with tables, graphs and figures. It is not of great interest to the general reader.

The study deals with some 1000 Negro and White children, aged seven to 14, in an area in North Carolina the authors call "Millfield." Most of the inhabitants work either in the fields or the mill—from which the town was given its name. Many of the people, Black and White, were poor but hardly impoverished. For country folk they were not "deprived," though the authors seem to think they were. Intelligence and academic achievement tests were administered to the children by a number of assistants. Also, a series of personality tests, interviews, questionnaires and ratings were given to pupils, teachers and parents.

The mean I.Q. (Stanford-Binet) for the White children was 98; for the Blacks, 85; the latter I.Q. being four to five points higher than the mean found for Negro children in Florida and Georgia. On the Primary Mental Abilities test (an intelligence test) the average score (called total quotient) was 95 for White children and 77 for Black children. In general, Negro boys scored lower than Negro girls. White boys and girls were approximately the same. On the Stanford Achievement Test (a school test) Black pupils were poorer than White throughout—about one year at the age of seven, and up to three to four years by fourteen. Kindergarten training appeared to benefit Black children more than White.

The interviews, questionnaires and ratings yielded little new. The teachers believed the sexes differ in motivation; Negro and White families differed widely in cultural advantages; Negro parents had more children, and these were less truthful, more aggressive and more given to misbehavior than Whites. The questionnaires apparently were well made, but difficulty in interpretation, understanding and co-operation of respondents made these instruments rather poor research tools.

The Minnesota Multiphasis Personality Inventory is most often employed with the mentally unstable. Results for school children are often—as here—contradictory and hard to interpret.

Whites and Blacks in Millfield live in a segregated environment, and the authors surmise that the community will remain so for a long time. Social life is entirely separate, and the community as a whole seems satisfied with their "separate and equal" policy. As good integrationists, the authors are not satisfied with the *status quo*. They recommend total school integration, in a fatuous belief that this will "narrow the gap" between the two races. It may do so, but at great cost to the White children.

HENRY E. GARRETT.

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